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ABSTRACT

An ongoing investigation of the process of reading diagnosis and remediation based on a theory of clinical problem solving called the "inquiry theory" has been undertaken by the Clinical Studies Group at the Institute for Research on Teaching. A review of several observational, computer simulation, and training studies conducted as part of the investigation reveals the following implications of the inquiry theory and the three kinds of study for teacher education: clinical problem-solving behavior seems to be determined by the clinician's memory, strategy, and the interaction between the two: clinical problem-solving behavior can be simulated by computer: case simulation is a useful, effective, and low-cost technique for training reading specialists and classroom teachers in diagnostic skills: and educators can be trained to make more precise diagnostic judgments given proper training involving simulated cases with feedback. This work demonstrates that significant improvements may be made in both consistency and specificity of diagnoses made by reading specialists and by classroom teachers. (FL)

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STUDIES OF CLINICAL PROBLEM SOLVING BEHAVIOR IN READING DIAGNOSIS

Doron Gil,
John F. Vinsonhaler,
and Christian C. Wagner

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Teachers' thoughts and decisions are the focus of studies currently under way at Michigan State University's Institute for Research on Teaching (IRT). The IRT, founded in April 1976 with a $3.6 million grant from the National Institute of Education, has major projects investigating teacher decision-making, including studies of reading diagnosis and remediation, classroom management strategies, instruction in the areas of language arts, reading, and mathematics, teacher education, teacher planning, effects of external pressures on teachers' decision, and teachers' perceptions of student affect. Researchers from many different disciplines cooperate in IRT research. In addition, public school teachers work at IRT as half-time collaborators in research, helping to design and plan studies, collect data, and analyze results. The Institute publishes research reports, conference proceedings, occasional papers, and a free quarterly newsletter for practitioners. For more information or to be placed on the IRT mailing list please write to: The IRT Editor, 252 Erickson, MSU, East Lansing, Michigan 48824.

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Studies of Clinical Problem-Solving Behavior in Reading Diagnosis[1]

Doron Gil,
John F. Vinsonhaler, and Christian C. Wagner[2]

Many of today's students are experiencing reading problems. For many, these problems are rooted in a failure to acquire specific and essential reading techniques in the early grades. Since reading instruction in the classroom is developmental (Carter & McGinnis, 1970), these children's reading deficiencies are likely to accumulate. Moreover, since reading is a fundamental prerequisite to most learning, such deficiencies interfere with the students' general learning (Wilson, 1977), and, as such, the children do not perform up to their potential (Sherman, 1968).

Unfortunately, referring students with such deficiencies to reading specialists does not guarantee adequate treatment of their problems. Appropriate remediation depends upon the effectiveness of the reading clinician in diagnosing and treating each child and his/her specific reading problems. This effectiveness is all too often less than optimal; however, limited knowledge and understanding of what constitutes good clinical diagnosis and remediation inhibits the improvement of training for teachers and reading clinicians in these areas (Stephens, Note 1).

Several questions need to be answered: What is the nature of effective diagnosis and treatment? What can schools, parents, reading clinicians, and classroom teachers do to help identify children with reading defects and oversee their remedial programs?

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[1]Paper presented at the First Behavioral Studies Conference, University of Missouri-St. Louis, October 1978.

[2]Doron Gil is an IRT research intern with the Clinical Studies Project. John F. Vinsonhaler is coordinator of that project and a professor of educational psychology. Christian C. Wagner is the systems analyst for the project.

The Clinical Studies group at the Institute for Research on Teaching (IRT) has been investigating the process of reading diagnosis and remediation for the past two years in an attempt to obtain answers to these questions.

The mode of investigation undertaken by the group is based on a theory of clinical problem solving called the "Inquiry Theory" and has two general objectives: (1) better understanding of clinical problem-solving behavior of reading clinicians and classroom teachers; and (2) application of research findings to the training of teachers and reading clinicians in diagnosis and remediation skills.

Three kinds of study are included in the investigation:

1. Observational studies, in which reading clinicians or classroom teachers are observed as they interact with simulated cases of children with reading difficulties;

2. Computer simulation studies, in which researchers explore the implications of the Inquiry Theory by programming a computer to simulate the diagnostic and remediation behavior described by this theory (these "simulated" clinicians reflect both ideal and typical approaches of reading clinicians to diagnosis and remediation); and

3. Training studies, in which instruction is guided by the Inquiry Theory concepts. Students enrolled in reading diagnosis and remediation classes are given simulated cases with which to interact, and computer-based decision aids to guide this interaction in order to improve their diagnostic skills.

This paper will describe the major tenets of the Inquiry Theory, the three types of study which relate to it, and the implications of these studies for future diagnosis and remediation of children with reading difficulties.

The Inquiry Theory

The Inquiry Theory originated in the medical education research "Inquiry Project" conducted at Michigan State University by Elstein and Shulman (Elstein, Shulman, & Sprafka, 1978). It was subsequently refined

by the Clinical Studies group (Vinsonhaler, Wagner, & Elstein, Note 2). The Inquiry Theory describes the behavioral domain in which a clinician (e.g., a physician, a reading specialist, a teacher) interacts with a case (e.g., a patient, a student) to reach diagnostic and treatment decisions about the case's problems.

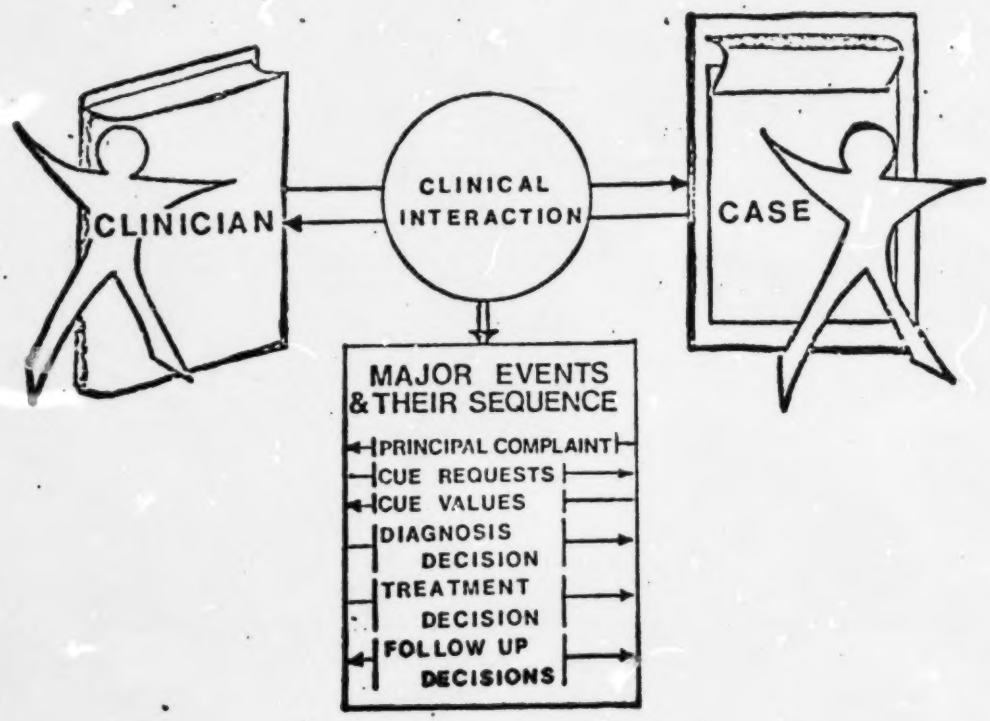

Figure 1. The Clinical Interaction

In describing this behavioral domain, the Inquiry Theory attempts to predict those characteristics of the clinical interaction which will occur (and be observed) repeatedly. The Inquiry Theory postulates that clinical diagnosis, or clinical problem solving, is determined by the interaction of clinical memory (consisting of sets of problems, cues, treatments, and the relationships among them), clinical strategy (the

sequencing of the mental tasks performed by the clinician), and the case.

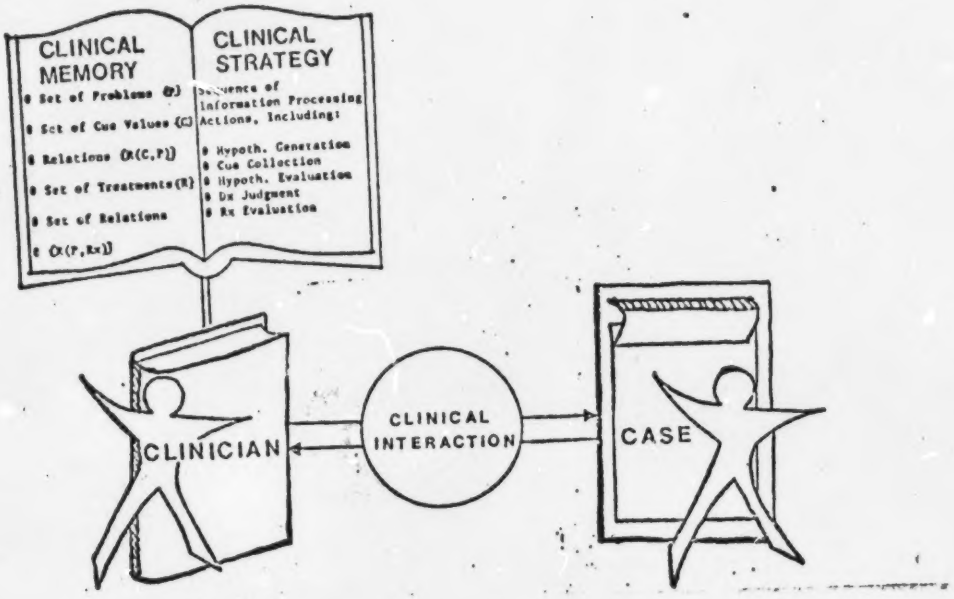

Figure 2. Problem Solving:
Interaction of Memory, Strategy, and Case

There are six information-processing tasks which characterize the clinical encounter between clinician and case:

1. Cue acquisition: the gathering of data, beginning with initially available cues.

2. Hypothesis generation: the generation of alternative assumptions about the case's problems based on a limited number of cues.

3. Cue interpretation: interpretation of the data based on the cues collected and the hypotheses under consideration.

4. Hypothesis evaluation and diagnosis judgment: estimation of the probable validity of each hypothesis in order to reach a diagnostic judgment.

5. Treatment evaluation: estimation of the expected gain for each of the possible treatments.

6. Prescription selection: selection of the specific methods of remediation based on the evaluation of the possible treatments.

Case Simulation

The different studies of the clinical encounter and the tenets of the Inquiry Theory all use simulated cases of a client's problems. These simulations are based on the problems of real clients, and they represent the relevant behaviors of the clients. Basically, a case is a set of information that the clinician can collect.

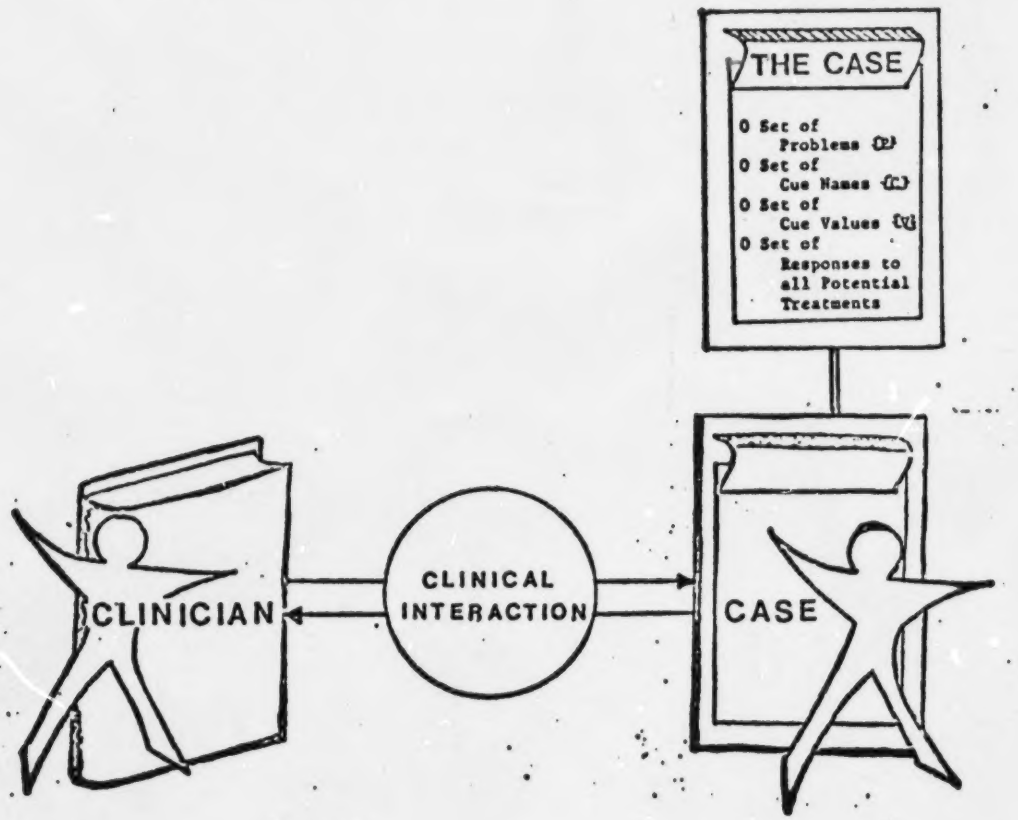

Figure 3. The Case

Two forms of simulated cases have been developed: manual based and computer based. The manual-based case consists of various types of information about a child's reading performance (e.g., background data,

school records, different tests that the child performed, etc.) which is stored in a box and retrieved manually. The computer-based case consists of the same information, stored in a computer file and retrieved via computer terminal.

The use of simulated cases is essential in diagnosis and remediation studies for several reasons: (1) They provide a means for presenting the child's behaviors to the clinicians; (2) They allow replications of clinical encounters with the same case (and with same or different clinicians), and thus enhance objectivity; (3) They may prove to be a low cost tool in the training of clinicians; and (4) They may be effective in training clinicians and educators on diagnostic skills under immediate feedback.

Review of Studies

Observational Studies

Three observational studies were conducted during 1977 and 1978, each focusing on the clinical problem-solving behavior of reading specialists, learning disabilities personnel, and classroom teachers as they diagnosed children's learning difficulties. In all three studies, manually-based simulated cases of learning difficulties were used, and the procedures in all three were similar (Bader, Vinsonhaler, Gardner, Wagner, Shulman, Elstein, & Weinshank, Note 3).

An observational session was held in which the clinician (reading specialist, learning disabilities personnel, or classroom teacher) interacted with a simulated case of learning difficulties to reach diagnostic decisions about the child's performance. The clinician was given an inventory of information about the child and was instructed to ask for any information he/she wanted that was in this inventory.

As the clinician examined the information, he/she was asked to talk aloud and verbalize his/her thinking. The experimenter encouraged the clinician to talk aloud throughout the session. Meanwhile, a clinical observer (a reading specialist or a teacher with a reading background) sat behind a one-way mirror, audiotaping the session and recording all information requested by the clinician, the time of each request, and the clinician's comments (recorded verbatim). Immediately after the observational session, the clinician was instructed to write down his/her diagnostic judgments about the case and to formulate a general plan for remediation. A debriefing session was then held, during which the clinician discussed the problem-solving approach he/she had used while requesting and evaluating information about the case. (Stimulus recall techniques were used to help the clinician recall this information.) Each clinician interacted with two simulated cases; the second case was either a replication of the first or a different case altogether.

Data analysis consisted of process and product measures. Process measures included such variables as number of hypotheses generated by the clinician during the session, number of cues (items of information) requested, and sequencing and organization of the information. Product measures focused on diagnostic consistency (how consistent the clinician was in describing the child's performance across two cases) and diagnostic commonality (how closely the clinicians agreed with themselves and with each other in their diagnoses). Also included in the product measures was a comparison between the clinician's final diagnosis and the criterion diagnosis written by an expert clinician.

Preliminary results from these studies indicate that diagnostic agreement among clinicians is low, both on individual clinicians' performances on alternate forms of the same case, and on individual

diagnosis compared to the diagnoses of other clinicians. This means that the reliability of clinicians' diagnoses is low. Furthermore, agreement and consistency do not appear to be functions of time taken to diagnose a case. Rather, they are related to the number of duplicate cues (items of information) the clinician examines across cases. This may indicate that clinicians employ heuristic or systematic data collection plans across cases (Weinshank, Note 4).

Computer Simulation Studies

Computer simulation studies of the clinical problem-solving behavior of reading specialists are another means by which knowledge of effective clinical problem solving can be gained. In such studies, a computer is programmed to simulate a clinician and his/her interaction with simulated cases of reading difficulties.

According to the Inquiry Theory, the behavior of a clinician is a function of his/her memory and strategy (Vinsonhaler et al., Note 2). Therefore, a clinician can be simulated by programming a memory and a strategy and the interaction between the two, and a case where changes in memory, in strategy, or in both will be reflected in changes in the clinician's performance.

In computer studies, this simulated clinician interacts with a simulated case of a child with reading difficulties. Throughout the interaction, the computer uses its memory and strategy to arrive at a diagnosis for a child, employing a process similar to the one applied by human clinicians.

The interaction between the simulated clinician and the case starts when the computer receives some basic information about the child's reading status. With this information, the computer proceeds to collect more

information, on the basis of which it generates hypotheses about the child's reading problems. Then it collects still more information to check out these hypotheses. (This process is known as hypothesis-directed inquiry; hypotheses about the child's problems are generated, and information is collected to confirm or disconfirm these hypotheses.) At this point, the simulated clinician begins final diagnosis.

Different memories and strategies may be used to create different clinicians. This allows for a wide variety of clinician-case interactions and, hence, a wide variety of potentially useful diagnostic decisions. The effects of the diagnostic outcomes are analyzed and the increased understanding of the clinical diagnostic process that is obtained can be applied to the training of human clinicians.

A recent computer simulation at the IRT focused on the impact of routine cue collection (the collection of some basic information about a case prior to hypothesis generation) on the clinician's performance (Vinsonhaler, Note 5). Observational studies with human clinicians had indicated that some clinicians use a routine cue collection procedure (or heuristic) at the beginning of every interaction with a new case, while others do not. The question then became, How significiant is routine cue collection to the diagnostic process?

To answer this question, several simulated clinicians were programmed to diagnose cases of reading disability using a routine cue collection. Others were programmed not to use such a heuristic. The performances of these simulated clinicians, as well as those of human clinicians (who had diagnosed the same cases in one of the observational studies), were analyzed.

Results indicated that simulated clinicians which used routine cue collection significantly outscored those which did not employ such a

routine, but still fell short of the humans' performances. This finding suggests that reading specialists and classroom teachers should be trained to use routine cue collection as part of their diagnostic processes.

Another computer simulation study investigated how the process of hypothesis generation is affected by different "certainty thresholds." The certainty threshold is how probable the hypothesis must be to be seriously considered during the diagnostic workup. The higher the threshold, the lower the number of hypotheses that will be considered; the lower the threshold, the greater the number of hypotheses that will be considered. This distinction between high and low thresholds can be seen in medicine, where students are trained to accept many hypotheses at the beginning of their encounters with patients, narrow these down to the most probable ones, and then study those very carefully.

To examine the effect of different thresholds, several simulated clinicians were created. Some were programmed to be more receptive to new hypotheses in the beginning of the diagnostic session and less receptive in the later part; that is, they were programmed so that as the clinical interaction proceeded, their certainty thresholds rose. At the beginning of the session, many new hypotheses could be generated; by the end, few new hypotheses could be generated.

Another group of simulated clinicians was designed to be equally receptive to new hypotheses throughout the interaction. Like the other clinicians, they started the interaction by receiving an initial contact and collecting routine cues. However, when they generated hypotheses, the threshold of acceptance remained low for the entire session.

Results indicated that both kinds of clinicians -- those with varying thresholds and those with fixed, low thresholds -- generated most of their hypotheses at the beginning of the interactions. This suggests

that early hypothesis generation may be a necessary result of hypothesis-directed inquiry. This behavior, like routine cue collection, may be important in effective diagnostic process, and it should be considered in the training of physicians, teachers, and other clinicians in diagnostic skills.

Training Studies

The prime objective of training, or application, studies is to examine the application of clinical problem-solving theory in the training of reading specialists and classroom teachers. The instructional corollary from which this objective is derived states that if clinical performance is determined by the clinician's memory and strategy, then this performance may be improved by alterations in clinical memory and strategy.

One training study was carried out during the summer of 1977 with 36 graduate students (most of them already teachers) enrolled in a course in reading diagnosis at Michigan State University (Sherman, Note 6). The study addressed two basic questions: (1) Can teachers be trained to diagnose reading difficulties in a manner similar to effective reading specialists? and (2) Does the instructional corollary hold for reading diagnosis?

To answer these questions, the instruction in the course was explicitly guided by the principles of the Inquiry Theory. Pre- and posttests consisting of two instruments were administered.

First, a memory battery association test examined the students' recall of problems in reading. It measured how well the students matched information to cue association (i.e., located specific findings about a child's reading performance); how well they matched cue to factor association (i.e., identified important strengths and weaknesses given a set of findings); and how well they matched factor to cue association

(i.e., identified important cues in testing hypothesized strengths or weaknesses).

The second test was a diagnostic performance test, which examined the students' capacity to accurately diagnose simulated cases of reading difficulty. This test consisted of a set of materials designed for use with simulated cases to study diagnostic performance. It included standardized instructions, response forms, and scoring keys intended to facilitate the students' interaction with the simulated cases.

In addition to the traditional presentation of course content by the instructor, the students interacted with manual-based and computer-based simulated cases of reading difficulty, using the materials from the diagnostic performance tests. At the end of the course, the students took the memory battery association posttest and the diagnostic performance test; the latter was administered as the students interacted with different simulated cases.

Results showed that the students did learn to diagnose in a manner similar to reading specialists, as indicated by increases in their mean diagnostic score. Also, the learning of clinical memory seemed to be related to the learning of clinical diagnostic performance.

Summary and Implications for Teacher Education

The Inquiry Theory and the three kinds of study derived from it have important implications for teacher education. First, clinical problem-solving behavior seems to be determined by the clinician's memory, strategy, and the interaction between the two. Therefore, clinical problem-solving performance can be improved by providing clinicians with external training aids to memory and to strategy. Second, clinical problem-solving behavior can be simulated by computer; this means that through the alteration of memory and strategy, simulated clinicians can be built

to represent both typical and ideal approaches to problem solving (e.g., with or without heuristics). Consequently, clinicians can be trained to use effective problem-solving approaches as indicated via the computer simulations. Third, case simulation is a useful, effective, and low-cost technique for training reading specialists and classroom teachers in diagnostic skills. Fourth, educators can be trained to make more precise diagnostic judgments given proper training involving simulated cases with feedback. Finally, this work demonstrates that significant improvements may be made in both consistency and specificity of diagnoses made by reading specialists and by classroom teachers.

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